1723-1
(2nd Manual)

INSTRUCTION MANUAL

Talonic

INDUSTRIES, INC

1723-1
(2nd Manual)

MODEL HD-4

SERIAL NO. 5098

SWEEP GENERATOR

Telonic INDUSTRIES, INC. BEECH GROVE, INDIANA

WARRANTY

TELONIC INSTRUMENTS AND ACCESSORIES

Products manufactured by TELONIC INDUSTRIES, INC. are guaranteed against defective materials and workmanship for a period of one year (vacuum tubes excepted) from date of purchase. This warranty does not apply to instruments that have been altered, improperly handled or damaged in any way beyond our control.

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications, without incurring any liability to modify equipment previously sold.

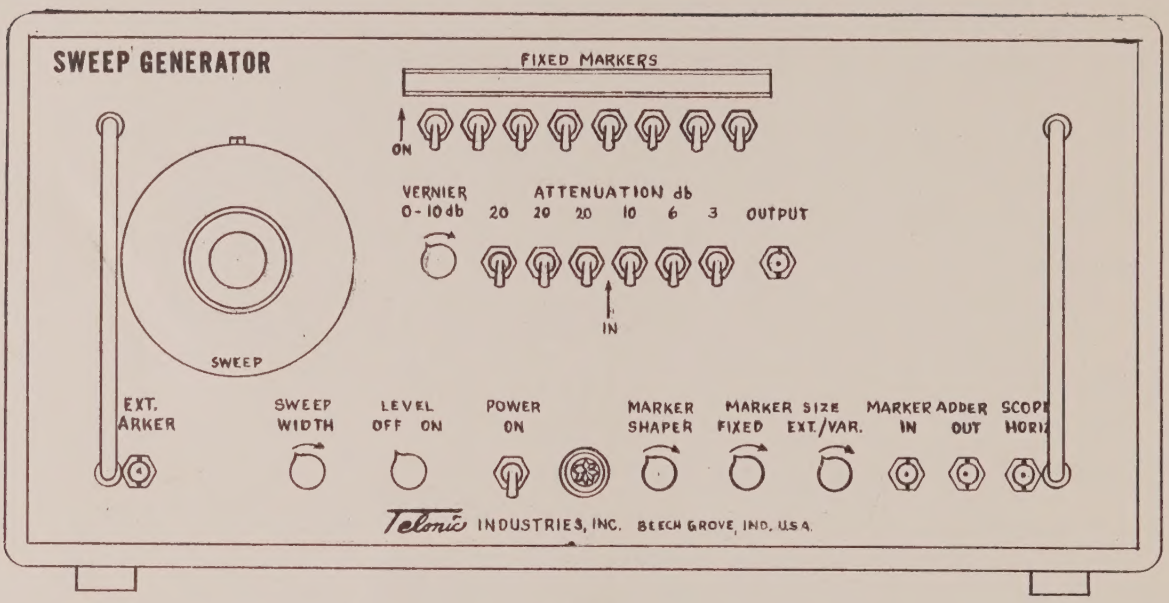
RETURNING EQUIPMENT TO FACTORY

Factory service is available for repair and readjustment of this instrument. However, a description of the trouble, plus the MODEL AND SERIAL NUMBERS of the unit should be forwarded FIRST, whereupon instructions for correcting the trouble OR authorization for returning the equipment will be given. This applies to all units, whether under warranty or not.

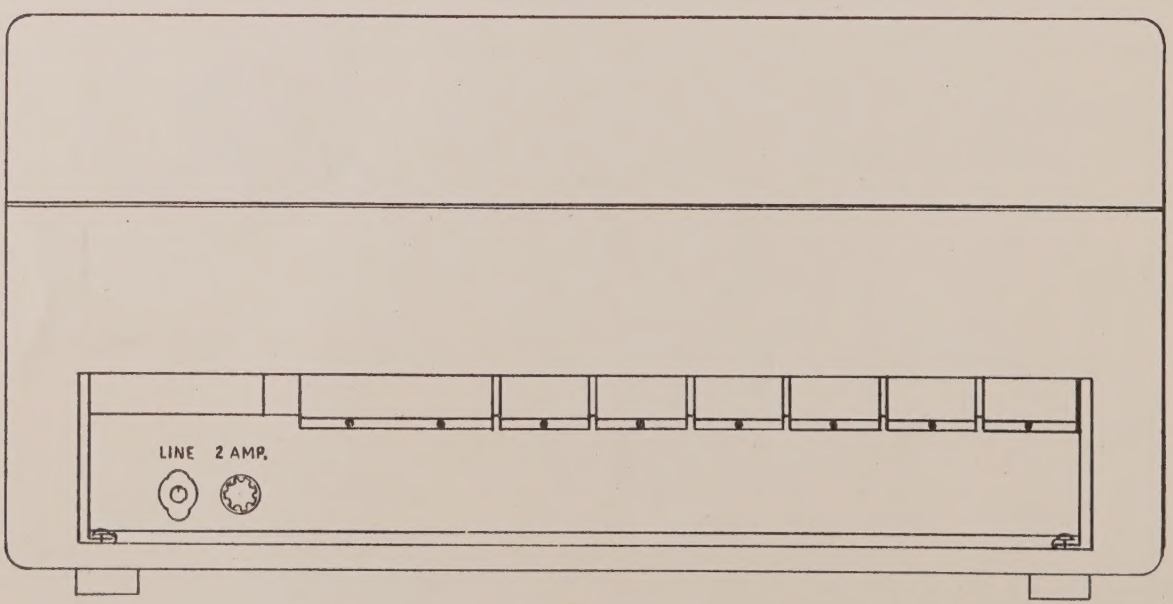
SPECIFICATIONS

MODEL HD-4 SWEEP GENERATOR

CENTER FREQUENCY	10 KC to 10 MC
FREQUENCY RANGE	10 KC to 15 MC
SWEEP WIDTH	25 KC to 10 MC
OUTPUT	
Voltage	1 volt peak to peak
Impedance	50 ohms
Flatness	5% over maximum sweep width
ATTENUATION	
Toggle Switch	20,20,20,10,6,3, db.
Vernier	0 to over 10 db.
DISPLAY LINEARITY	Normally below 1.2:1
RADIATION	Less than 10 microvolts
SWEEP RATE	Line frequency (50-60 cps.)
ZERO BASE LINE	Oscillator off 50% of the time during return sweep.
SCOPE HORIZONTAL SWEEP	Approximately 14 volts peak to peak.
SOURCE VSWR	Normally below 1.2:1
POWER	115V 50/60 cps. 100 watts
MARKER SYSTEM	
Plug-In Crystal Markers	Provisions are normally included for up to eight plug-in crystal controlled markers. These may be specified according to type and frequency and may be included when the instrument is ordered or added at a later date. See our literature for further details regarding these markers.
External Marker Input	An external CW signal of approximately 0.1 volts may be used to produce a "birdy" type marker.
Birdy-By-Pass Marker	The output of the marker oscillators is mixed with a signal from the sweep oscillator to produce beatnotes or birdies. These are amplified and superimposed upon the detected RF output signal before it is applied to the vertical scope input. Amplitude and shape of the markers are adjustable over a wide range.
PHYSICAL DESCRIPTION	Panel Size 1/8" x 8 3/4" x 19" Chassis size 2" x 14½" x 17"


SWEEP GENERATOR
FIXED MARKERS
ON
VERNIER
0-10db
ATTENUATION db
20 20 20 10 6 3
OUTPUT
IN
SWEEP
EXT.
ARKER
SWEEP
WIDTH
LEVEL
OFF ON
POWER
ON
MARKER
SHAPER
MARKER
FIXED
SIZE
EXT/VAR.
MARKER
IN
ADDER
OUT
SCOPE
HORIZ
Telonic INDUSTRIES, INC. BEECH GROVE, IND. U.S.A.

FRONT

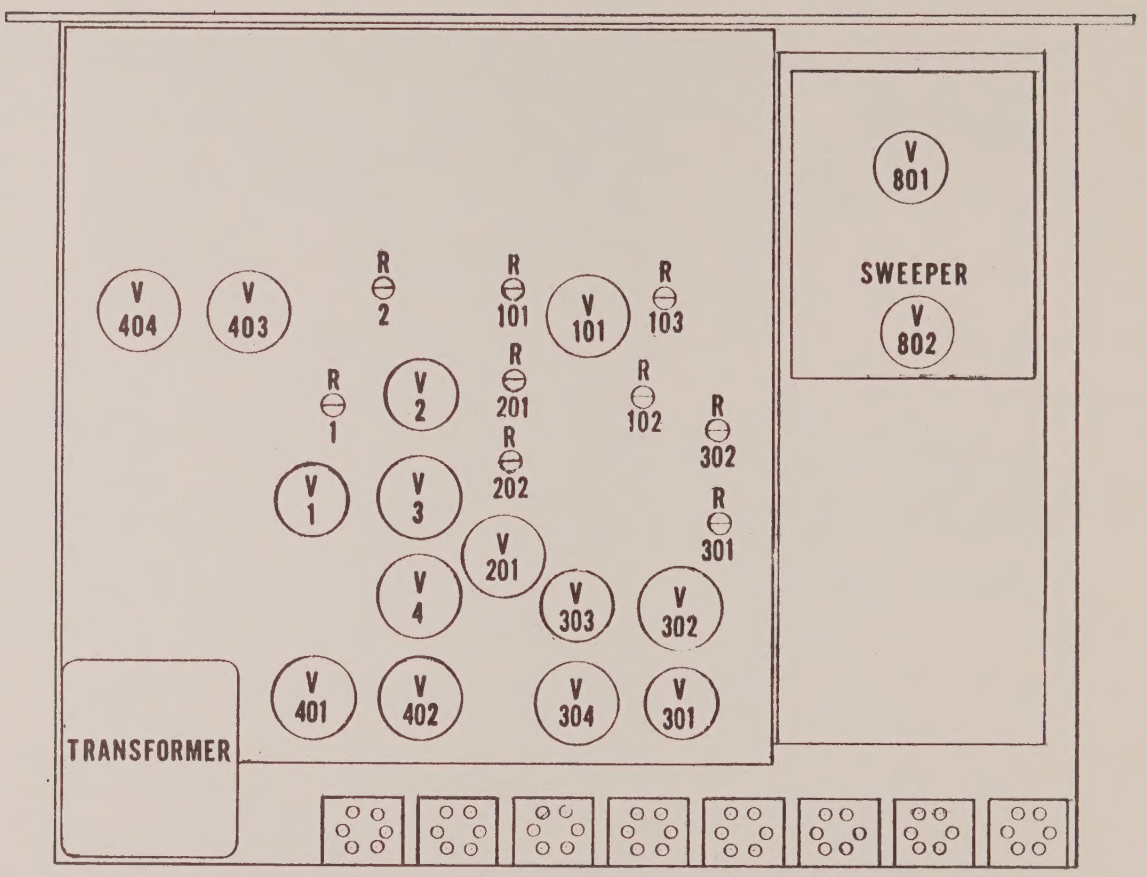

LINE 2 AMP.

REAR

DESCRIPTION OF FRONT PANEL

SWEEP DIAL	Indicates Center frequency of the sweep oscillator at minimum sweep width.
VERNIER ATTENUATION	Provides 0-10 db. of vernier attenuation.
TOGGLE SWITCH ATTENUATOR	Provides the indicated amounts of step attenuation.
OUTPUT	RF Sweep output - BNC Connector - Impedance 50 ohms.
EXTERNAL MARKER	Marker input for external signal source.
SWEEP WIDTH	Varies the amount of voltage supplied to the vibrating capacitor and can be used to vary the sweep width.
LEVEL ON/OFF	Should be in ON position when operating at frequencies above 500 kc. and OFF position when operating at frequencies below 500 kc.
POWER ON	Switches AC power ON and OFF.
MARKER SHAPER	Varies the width of the marker signals.
MARKER SIZE Fixed	Varies the amplitude of the fixed markers (crystal plug-in units).
Ext/Var	Varies the amplitude of the external marker signal.
MARKER ADDER In	The demodulated signal from the device being tested is fed into this connector so that marker signals may be superimposed.
Out	This connector should be connected to the vertical input terminals of the scope for viewing the demodulated signal and markers.
SCOPE HORIZONTAL	This connector should be connected to the scope horizontal amplifier input.
FIXED MARKERS	These switches supply B+ to the fixed markers (crystal plug-in units) when in the "ON" Position.

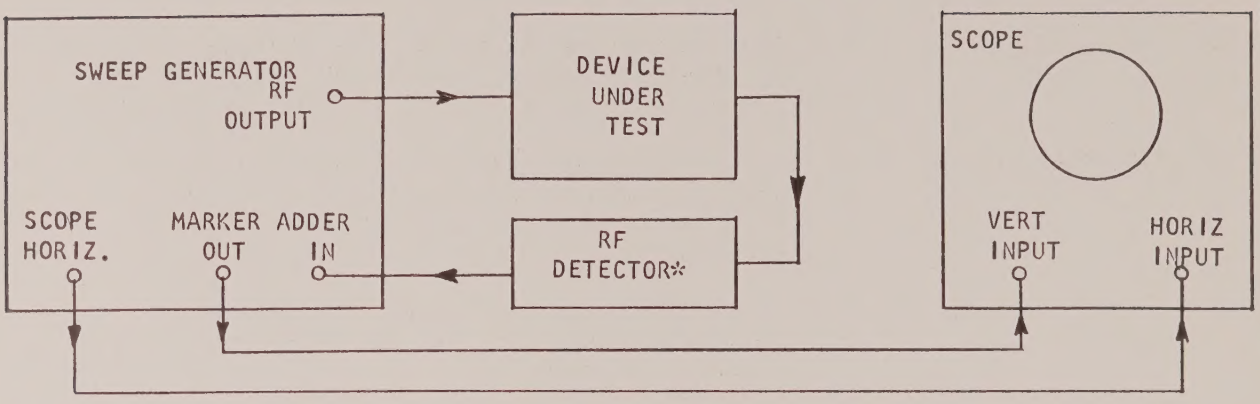
CHASSIS LAYOUT



V1	5651
V2	6AU6
V3	EL84/6BQ5
V4	EL84/6BQ5
V101	12AX7
V201	12AX7
V301	6AU6
V302	12AX7
V303	6AU6
V304	EL84/6BQ5
V401	12AX7
V402	12AX7
V403	12AX7
V404	12AX7
V801	12AV7
V802	12AV7

DESCRIPTION OF CHASSIS CONTROLS

R1 - B+ ADJUST	This control varies the bias on the amplifier, (V2), for the B+ regulator, (V3), and is adjusted to produce a regulated B+ voltage (B+2) of 175 volts.
R2 - SWEEP WIDTH LIMIT	This potentiometer controls a voltage supplied to the front panel SWEEP WIDTH control and is used to adjust the sweep width when the front control is set at maximum.
R101 - HORIZONTAL PHASE	This control adjusts the phase of the scope horizontal sweep voltage with reference to the phase of the sweep oscillator.
R102 - LINEARITY	This control can be used to change the waveform of scope horizontal output (V101). It is normally set for best linearity at maximum sweep width.
R103 - HORIZONTAL SIZE	This control adjusts the size of the horizontal output when the Front Panel Sweep Width control is set to its maximum position. It is adjusted to maintain a constant horizontal size at all sweep width settings.
R201 - BLANKING PHASE	This control adjusts the phase of the blanking pulse with reference to the phase of the sweep oscillator.
R202 - BLANKING WIDTH	This control is the grid resistor for the blanking pulse generator (V201). It is adjusted to blank one-half of the sweep cycle to produce a zero base line.
R301 - LEVEL MAXIMUM	This control is used to adjust the output level when the front panel LEVEL control is at its maximum position.
R302 - LEVEL MINIMUM	This control is used to adjust the output level when the front panel LEVEL control is at its minimum position. (On units that use no front panel LEVEL control the LEVEL MAXIMUM control on the printed circuit board controls the average B+ voltage supplied to the sweep oscillator and is used to adjust the RF output to a value as shown on the specification sheet. On these models the LEVEL MINIMUM control performs no function.)



TYPICAL SET UP - The following procedure is recommended for setting up this instrument in test position.

1. Connect unit to proper power line voltage and turn POWER ON switch to ON position.

2. Make connections to the scope, the device under test, and RF Detector as shown above. All connectors located on the sweep generator are BNC type and it is recommended that RG cable be used for all connections. This insures good ground connection between each device, minimizes hum, leakage from unit and pick up of spurious external signals. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator. If the input impedance of the device under test is different than the impedance of the sweep generator, a matching network should be used to insure a constant input signal.

3. Adjust the RF output level by means of the OUTPUT LEVEL or VERNIER ATTENUATOR control and the step RF ATTENUATOR to the proper input signal for the device being tested. Failure to do this will result in incorrect reading on the scope.

4. Adjust the SWEEP WIDTH control and center frequency SWEEP DIAL to cover the desired frequency range.

5. MARKERS
   Markers may be produced by one or more of the following methods depending on the specific unit.
   A. Plug-in crystal markers (C type).
   B. Plug-in crystal harmonic markers (CDH or CH type).
   C. Internal variable marker.
   D. External CW Signal.
   First turn on marker unit or inject external CW signal and adjust MARKER SIZE and SHAPER until markers are of a convenient size and width.

*See Telonic literature for detector recommended for use with this instrument.

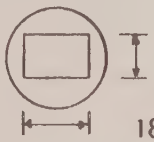
INTERNAL CONTROL ADJUSTMENT

THE INTERNAL CONTROLS are adjusted at the factory and normally do not require any readjustment, however, should it be desirable to check these adjustments, follow these steps:

1-Connect the unit as shown under operating instructions but omit the device under test. The recommended detector for this unit is the Telonic XD-8 for units with 50 ohm RF output impedance and the Telonic XD-9 for units with 75 ohm RF output impedance. Turn unit on.

2-B+2 ADJUSTMENT: Adjust R1 to provide a regulated B+ voltage of 175 volts (blue wire).

3-BLANKING PHASE and WIDTH ADJUSTMENTS: First set attenuator, switches and vernier for maximum RF Output, SWEEP WIDTH control in its maximum counter-clockwise position and MARKER SIZE controls in their counter-clockwise position. A rectangular pattern should appear on the scope. If this pattern is not rectangular, adjust the BLANKING PHASE and WIDTH controls, R201 and R202, until a rectangular pattern is obtained.



Equal to Peak RF Output Approx.

18V. Approx.

A vertical line indicates no horizontal output, first check scope and connecting cables, then trouble shoot horizontal sweep section.

A horizontal line with zero amplitude indicates no RF Output. First check scope, RF Detector, and connecting cables. Adjust R301 (see step 4). Refer to Maintenance, Page 13.

A horizontal line deflected above zero indicates no blanking. Trouble shoot the blanking generator.

BLANKING PHASE

Misadjusted

BLANKING WIDTH

Misadjusted

BLANKING PHASE & WIDTH

Misadjusted

4-RF OUTPUT LEVEL ADJUSTMENT: Adjust LEVEL MAXIMUM control, R301, until the vertical height of the pattern equals the peak to peak RF voltage shown on the specification sheet, Page 1. Since the RF Detector is approximately 90% efficient, the actual RF output voltage will be slightly higher than the voltage shown on the scope.

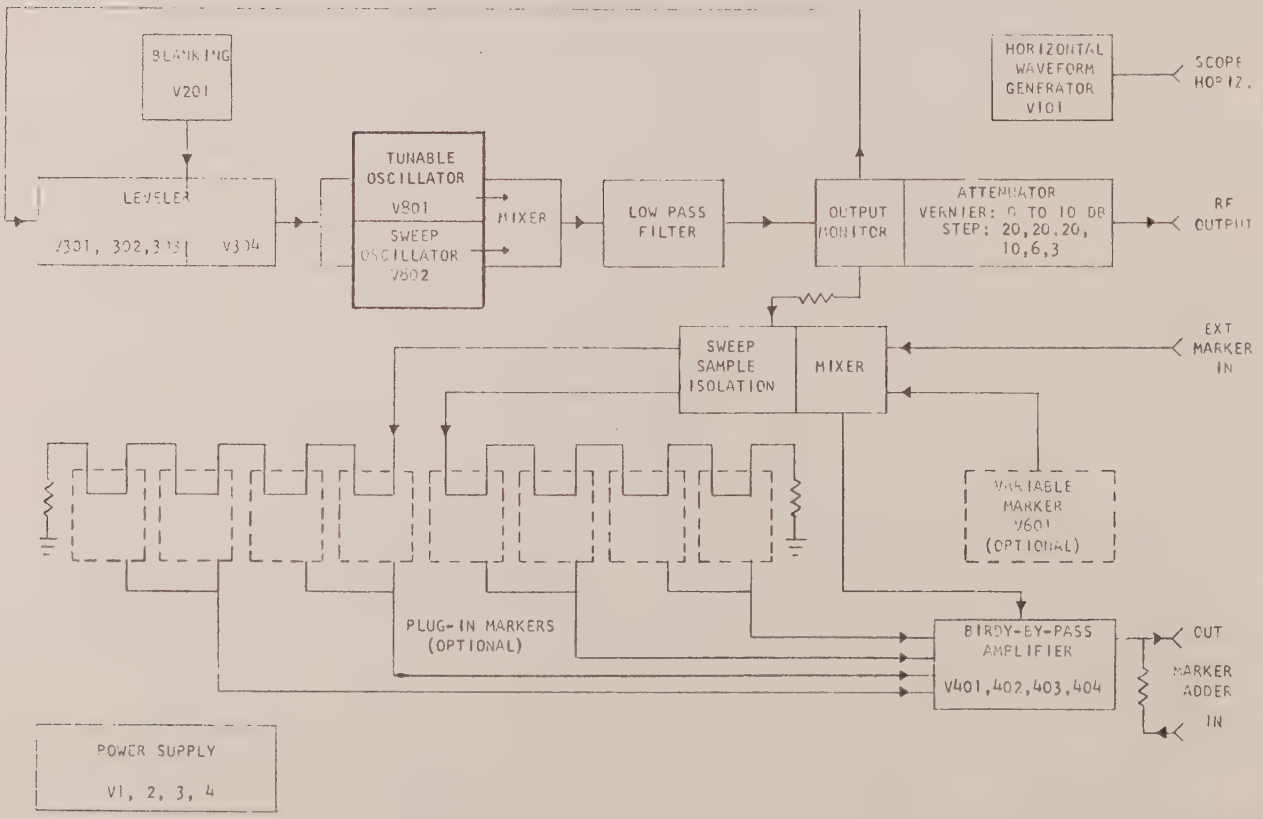
5-HORIZONTAL PHASE and SIZE ADJUSTMENTS: Set SWEEP WIDTH control to its maximum clockwise position. If pattern is not rectangular, adjust HORIZONTAL PHASE, R101, until a rectangular pattern is obtained. If the HORIZONTAL SIZE has increased or decreased, adjust HORIZONTAL SIZE, R103, until the pattern has the same horizontal size as it had with the SWEEP WIDTH control in its counter-clockwise position.

MARKERS MUST BE PROVIDED FOR THE FOLLOWING ADJUSTMENTS

6-SWEEP WIDTH ADJUSTMENT: With the SWEEP WIDTH control on the Front Panel in its maximum clockwise position, adjust the SWEEP WIDTH LIMIT, R2, to provide the maximum sweep width as shown on the specification sheet, Page 1.

7-LINEARITY ADJUSTMENT. Linearity may best be adjusted when a number of markers are present on the display. In the factory, a harmonic generator is used for this purpose. The LINEARITY control, R102, is adjusted for equal spacing between the markers. Adjusting the LINEARITY control will change the size of the Scope Horizontal Signal, therefore, the horizontal size must be readjusted (see step 5). The HORIZONTAL PHASE control also has an effect on linearity and can be adjusted slightly to obtain optimum linearity.

BLOCK DIAGRAM



SWEEP OSCILLATOR AND MIXER CIRCUITRY

The output of this unit is produced by the heterodyne method using two oscillators at a frequency of 3 or 4 times the highest output frequency. One oscillator is swept to produce the sweep width and the other oscillator is tuned to allow the center frequency of the output to be tuned. Four diodes in a bridge circuit produce the mixing of the two fundamental frequencies. Due to the balanced nature of this mixer, a high output is produced with a minimum of harmonic or spurious content. A low pass filter removes the fundamental frequencies and allows the output or heterodyne frequencies to pass out through the monitor and attenuator to the final output. The oscillator circuits are similar, and have similar frequency versus voltage and frequency versus temperature effects to minimize drift.

HORIZONTAL SWEEP OUTPUT CIRCUITRY

The horizontal sweep voltage is originated by a square wave producing circuit. The 6.3 V. "A" winding and 6.3 V. "B" winding of the power transformer are connected in series to obtain a 12.6 voltage center-tapped to ground. This voltage is connected through a phasing network to the grid of V101 (12AX7). The tube then clips and amplifies the grid signal so that a square wave is produced at the plate. This square wave is then applied to the second triode through an RC network. This network is designed to produce a non-linear sawtooth waveform. A potentiometer in this circuit allows the shape of the waveform to be adjusted. The second triode is connected as a cathode follower, and produces the same sawtooth output. This horizontal sweep voltage compensates for the non-linear characteristics of the vibrating sweep capacitor at high sweep widths.

At sweep width from minimum to about 50%, the vibrating sweep capacitor is quite linear. In order to maintain almost perfect linearity for all values of sweep width, a potentiometer is ganged with the sweep width potentiometer which automatically changes the scope horizontal sweep voltage from a sinusoidal waveform at low sweep width settings to a distorted sawtooth waveform at the high sweep width settings.

BLANKING CIRCUIT

The purpose of the blanking circuit is to produce a zero base line by removing B+ from the Sweep Oscillator during the sweep retrace. The blanking voltage is originated by a square wave producing circuit. A phased 6.3 volt sinewave is squared and amplified by the blanking tube. This square wave output of V201 controls V304 (EL84), the sweep oscillator voltage regulator tube, and thus deprives the Sweep Oscillator of voltage during one-half of each cycle. PHASE and WIDTH controls are provided for adjusting this blanking voltage.

AUTOMATIC OUTPUT LEVELING CIRCUITRY

The RF output from the Sweep Oscillator is monitored by a crystal diode detector. This detector, which is located inside the attenuator box, consists of two diodes in a half wave voltage doubler circuit. The use of a voltage doubler provides higher voltage and prevents erroneous leveling information from occurring due to harmonic content. The detector provides a negative output which is equal to approximately 75% of the peak to peak RF voltage.

The output from the detector is then amplified and used to control the plate voltage of the Sweep Oscillator. A small decrease in the detector output causes a

large increase in the B+ supplied to the RF Oscillator and thus counteracts any amplitude variation.

The LEVEL MAX control adjusts the bias on the first stage of the amplifier. This causes the DC levels in the entire amplifier to change, and varies the average B+ supplied to the Sweep Oscillator from a minimum of 25 volts to over 100 volts.

The operation of this circuit and of the Sweep Oscillator can be checked at the feed-thru capacitor on the end of the Attenuator box or Pin 1 of V301. The waveform at this point will normally show a flat output level over the entire band. Adjusting the OUTPUT LEVEL will change this level.

POWER SUPPLY

The power transformer output of 140 volts AC is fed into a half wave voltage doubler, using silicon rectifying elements CR1 and CR2. B+ is taken off the capacity input filter to provide +375 volts unregulated to the plates of V3 (B+ regulator pass tube), V304 (oscillator pass tube), and V4 (marker B+ pass tube.)

B+2 is the output of the electronic regulator circuit, consisting of V2 and V3, and provides +175 volts regulated. Potentiometer R1 controls the operating point of V2, regulator amplifier, and is set for proper B+2 output voltage.

B+3 is obtained by biasing the grid of V4 at approximately 85 volts positive, which causes current to flow through cathode resistor R20. The voltage at Pin 3, V4, is supplied to the Plug-In Markers and maintains its regulation due to the low impedance characteristics of the cathode follower circuit and provides approximately 100 volts.

The B- voltage is obtained by the half wave Silicon Rectifier CR3. Regulator tube V1 maintains this voltage at -82 volts, and supplies bias voltage to the leveler circuit as well as a reference voltage for the electronic regulator.

Resistor R4 acts as a fuse, protecting the transformer and rectifiers from overload.

The primary of the power transformer is normally wired for 115 volt AC line operation. However, it can be converted to operate from a 230 volt AC source if desired. This conversion is described in the maintenance section.

MARKER SYSTEM DESCRIPTION

GENERAL

A sample of the sweep signal is mixed with the fundamental or a harmonic of the crystal plug-in marker units or external signal to produce beatnotes or birdies. These birdies are then amplified and superimposed upon the demodulated swept signal and applied to the vertical amplifier of the oscilloscope. The size and shape of the marker may be varied over a wide range by the SIZE and SHAPER Control of the birdy amplifier.

EXTERNAL MARKER INPUT

The CW signal from the external marker input is fed into a diode mixer, where it is mixed with a sample of the sweep signal to produce birdies. The resultant birdy is then fed into the birdy-by-pass amplifier.

PLUG-IN MARKERS

This unit has provisions for a maximum of eight single frequency (C Type) crystal markers, eight harmonic (CH type) crystal markers, or four harmonic (CDH type), or any combination. Each CDH type marker occupies the space of two C or CH type.

Two sweep sample outputs are available from the sweep oscillator, in order to minimize coupling between marker signals. For optimum operation harmonic and single frequency markers should not be fed from the sweep sample line.

SINGLE FREQUENCY MARKERS (C TYPE)

These crystal markers are self-contained plug-in units. Additional units at other frequencies (within the range of the sweep generator) may be ordered and substituted for the original units.

The crystal oscillator units include the tube, crystal oscillator tuning, crystal diode mixer, and a tuned circuit selecting the sweep input frequency. A test point is provided for easy adjustment of the overtone crystal oscillator (this circuit used above 12 mc.). In making this adjustment, the crystal oscillator coil slug is adjusted for near maximum voltage at the test point. This is usually in the order of 2-5 volts as measured with a VTVM. The adjustment should be made just slightly off the peak on the low inductance side, since the effects of tuning are critical on the other side of the resonance curve. Crystal oscillators below 12 mc. are Pierce type oscillator circuits which require no tuning.

By tuning the sweep sample coil, the frequency of the sweep input signal can be varied and thus minimize unwanted markers generated from other harmonics of the crystal oscillator. The amplitude can be varied by adjusting the coupling.

HARMONIC MARKERS

Harmonics of a crystal-controlled oscillator are mixed with a portion of the sweep signal to produce a display of markers at regular intervals across the sweep range.

CH TYPE - This type utilizes a single tube and produces harmonic markers over a limited range.

CDH TYPE - This type uses two tubes and therefore will produce harmonics over a much larger range than the CH type. For example, the CH type, 1 mc., harmonic generator will produce harmonic markers to approximately 25 mc. where the CDH type, 1 mc., harmonic generator will produce markers to over 300 mc.
(See our literature on plug-in markers for additional information).

POWER SUPPLY: Since a defect in the power supply will affect all circuits, it should be checked for proper operation before proceeding to other circuits.

SUPPLY	NOMINAL VALUE	NORMAL VARIATION	NORMAL RIPPLE	WIRE COLOR*
AC Line	115V	----------	------	------
B+1	375	±15 Volts	6 to 15 volts	Red
B+2	175	±.5 Volts	12 to 25 millivolts	Blue
B+3	100	±5-10 Volts	15 millivolts to .5 volts	Orange
B-	-82	±2 Volts	100 millivolts	White
6.3 "A"	6.3V AC	Main filament supply		Green
6.3 "B"	6.3V AC	180° out of phase with supply "A". Source of phasing and filament voltages.		Gray
6.3 "C"	6.3V AC	Isolated filament voltage for tubes with cathodes above ground.		Brown

NEXT: If power supply is operating normal, use the block diagram to isolate the trouble to a major section. Check tubes, diodes, and adjustment of Front Panel and printed wiring board controls located within that section (see Page 7 for adjustment procedure). By the use of the schematic, ordinary difficulties encountered can be readily located and remedied. The following trouble-shooting chart is an additional aid to servicing:

SYMPTOM	POSSIBLE CAUSE AND REMEDIES
Pilot Light Off and Unit Fails to Operate	Fuse open - replace. If second fuse opens - look for cause of overload, shorted wiring, components, etc.
B+1 Off Value or Excessive Ripple	Check R4, C1, C2, CR1, and CR2.
B+2 Off Value or Excessive Ripple	Check R1 for proper adjustment. Check R15, it will burn out if B+2 is overloaded. Check V1, V2, V3, tubes and circuitry.
B+3 Off Value or Excessive Ripple	Check R17 and R21 (these resistors adjust the voltage on the grid of V4, a cathode follower, which in turn determines the voltage on the cathode). Check R18 (this resistor will burn out if B+3 is overloaded). Check V4 and C2.
B- Off Value or Excessive Ripple	Check C3, C4, C5, CR3, R3, R5, and R6. Check V1 to see if it is lit properly (should be a steady orange glow).

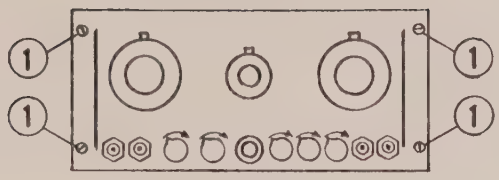
*Wire colors do not apply to shielded wires - single wires only.

V1 Not Lit Properly	If replacing V1 and checking the above parts does not remedy the trouble, check the line voltage. Low line voltage could cause this trouble. Reducing the value of R3 slightly will usually eliminate this difficulty.
RF Output is Low or Zero	Check R314 - this resistor will burn out if the B+ to the sweep oscillator is overloaded. Check B+ to the sweep oscillator, cathode of V304. It should be a positive square wave of 25-100 volts and should vary as the OUTPUT LEVEL control varies. If it is normal, look for RF difficulties, defective tube, components, shorted or open wiring, etc. Replace mixer diodes in sweeper box, observe polarity. If the voltage is low and does not respond to the LEVEL control, remove first V303 and then V201. When either of these tubes conducts, the voltage on the grid of V304 (pin 2) is reduced and thus decreases the B+ to the sweep oscillator. If removal of V201 allows the the B+ on V304 (pin 3) to return to normal, check the blanking tube, controls, and associated circuitry. If removal of V303 causes the B+ to return to normal, check the LEVELER controls, V301 and V302, tubes, and associated circuitry.
Poor Leveling	Replace monitor diode. Also replace V301, V302, and V303. V301 is the most critical since it is in the first stage of the DC coupled amplifier. Resetting the printed circuit LEVEL controls is sometimes necessary if these tubes are replaced.
Weak Markers	Replace IN82 or IN34 crystal diode mixer. Check Birdy-By-Pass Amplifier, tubes and circuitry.
No Horizontal Output	Look for difficulty in the sawtooth circuitry V101, using the printed circuit board layout and schematic to check waveforms and voltages.

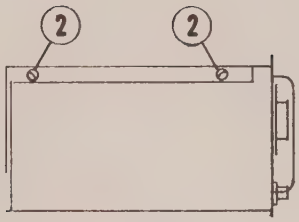
CONVERSION FOR 230 VOLT POWER LINES

The dual primary of the power transformer is normally wired in parallel for use on 115 volt AC lines. If desired, the windings can easily be reconnected in series for use with 230 volt power. With the aid of the Chassis Layout, bottom view, locate terminals 1, 2, 3, and 4. Remove the jumper wires between terminals 1 and 2 and between terminals 3 and 4. Then install a jumper wire between terminals 2 and 3.

RACK MOUNTED UNIT



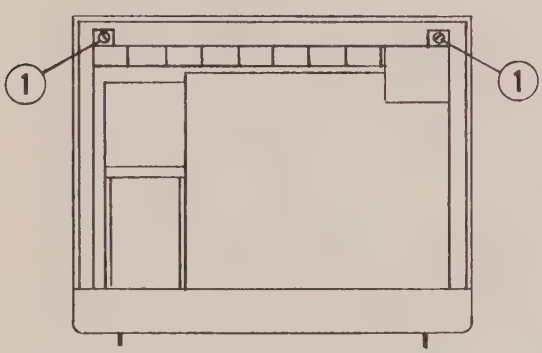
FRONT



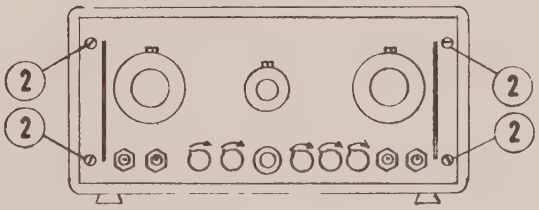
SIDE

Unit has front panel slotted or drilled for standard RTMA Mounting. Position unit in rack and install mounting screws in holes marked (1).
Dust cover removal: Remove four #8-32 thread-cutting screws, marked (2) (two on each side) and lift off cover for easy access to chassis.

CABINET MOUNTED UNIT



TOP



FRONT

To remove chassis from cabinet; first remove the two #8-32 screws (marked (1) on top view above) at the back of the chassis (one on each side). These screws fasten the chassis to the cabinet guide rails. Second, remove the four #10-32 screws (marked (2) in front view above). The screws hold the panel to the cabinet.

Slide chassis out of cabinet by pulling forward on the two front panel handles.

To replace chassis in cabinet, insert the flanges on the bottom of the chassis side panels into the slot of the cabinet guide rails. Push chassis back into cabinet far enough for the slots in the side panel flanges to align with the retained nut in guide rail. Install the two #8-32 screws and tighten securely. Replace the four #10-32 screws in the front panel.

PART VALUE INFORMATION

SCHEMATIC PART DESIGNATION		SCHEMATIC VALUE ABBREVIATION	
C	Capacitor	Ω	ohms
CR	Crystal Rectifier, Germanium Diode	KΩ	1,000 ohms
F	Fuse	MΩ	1,000,000 ohms (megohms)
I	Incandescant Pilot Light		
J	Jack or termination, Coaxial Connector	μf, uf	Microfarad
K	Cable	μμf, uuf	Micromicrofarad
L	Coil	μh, uh	Microhenry
M	Meter or Motor	mh	Millihenry
P	Plug, Coaxial Connector		
R	Resistor, Fixed or Variable		
S	Switch		
T	Transformer		
V	Tube		
Z	Miscellaneous		

RESISTORS - All resistors are ½ watt ± 10%, and are shown in ohms, unless otherwise specified.

NOTE: Resistors in the attenuator pads are ± 2%.

CAPACITORS - All capacitors are shown in micromicrofarads (uuf) unless otherwise specified.

COILS - All coils are shown in microhenries (uh) unless otherwise specified.

PARTS LOCATION - F.P. Front Panel
P.C.B. Printed Circuit Board
R.P. Rear Panel
C.H. Chassis
T.P. Test Point

PARTS NUMBERS - LOCATION INFORMATION

1 - 99 - Power Supply
101 - 199 - Horizontal and Alternate Sweep Drive Circuit.
201 - 299 - Blanking
301 - 399 - Leveler
401 - 499 - Birdy-By-Pass
501 - 599 - Mixer & Plug-In Markers
601 - 699 - Variable Markers
701 - 799 - Attenuators
801 - 899 - Sweep Oscillator and Sweep Drive Circuit
901 - 999 Modifications and Special Circuits

*Indicates value of component adjusted at factory, and may deviate from value shown on print.

—○— Indicates printed circuit board terminal.

N O T I C E

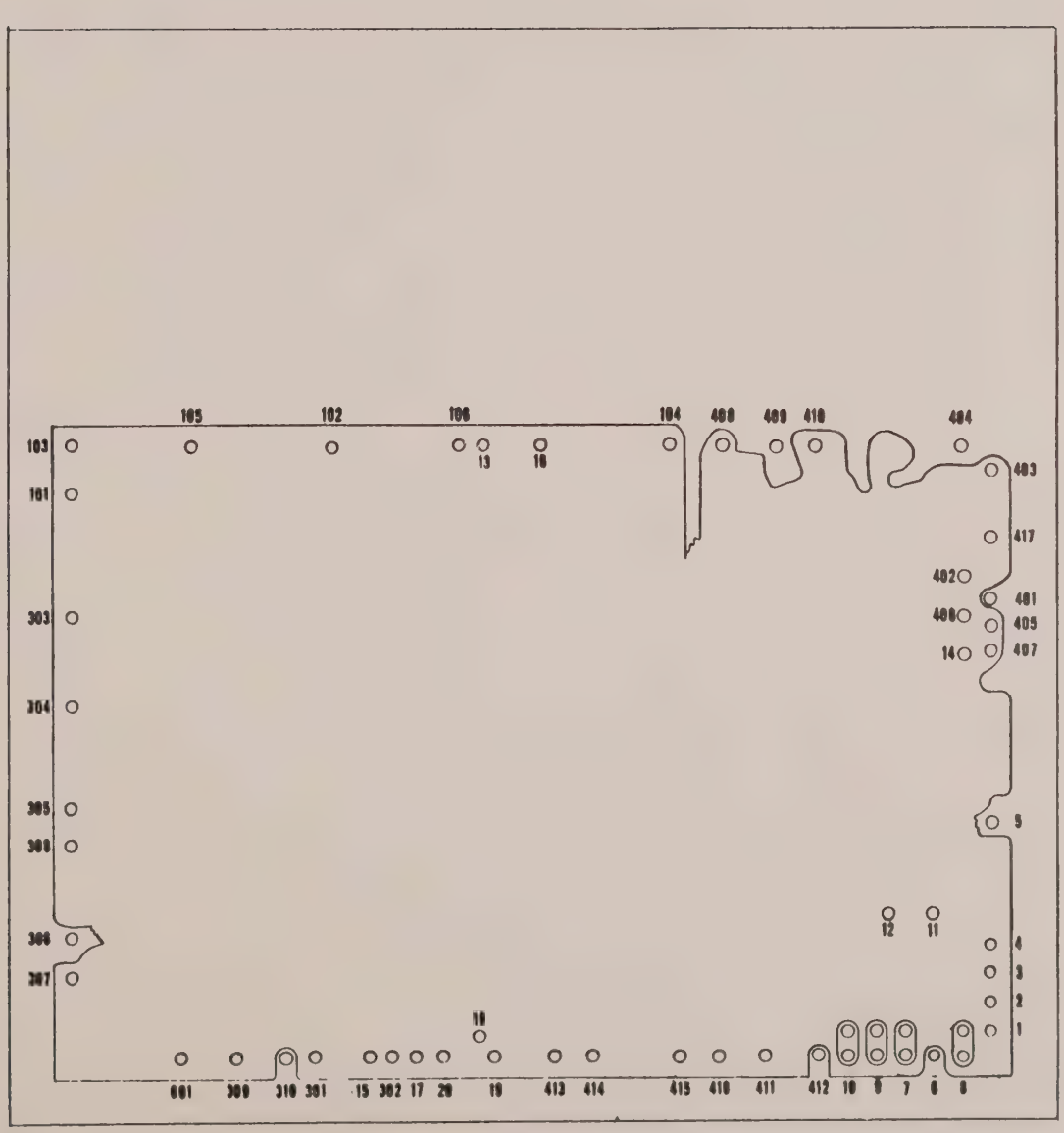
RED LACQUER IS USED TO INDICATE FASTENINGS THAT SHOULD NOT BE DISTURBED FOR ORDINARY SERVICE, AND TO SECURE ADJUSTABLE CONTROLS.

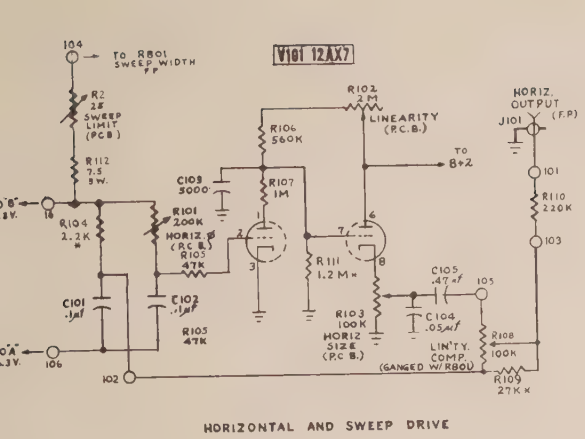
CHASSIS LAYOUT

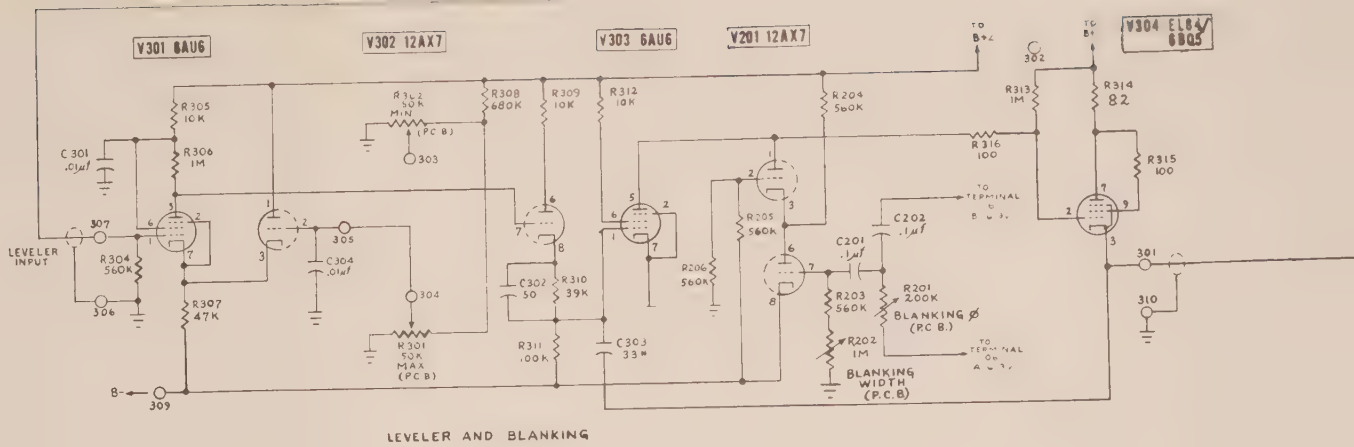
BOTTOM VIEW

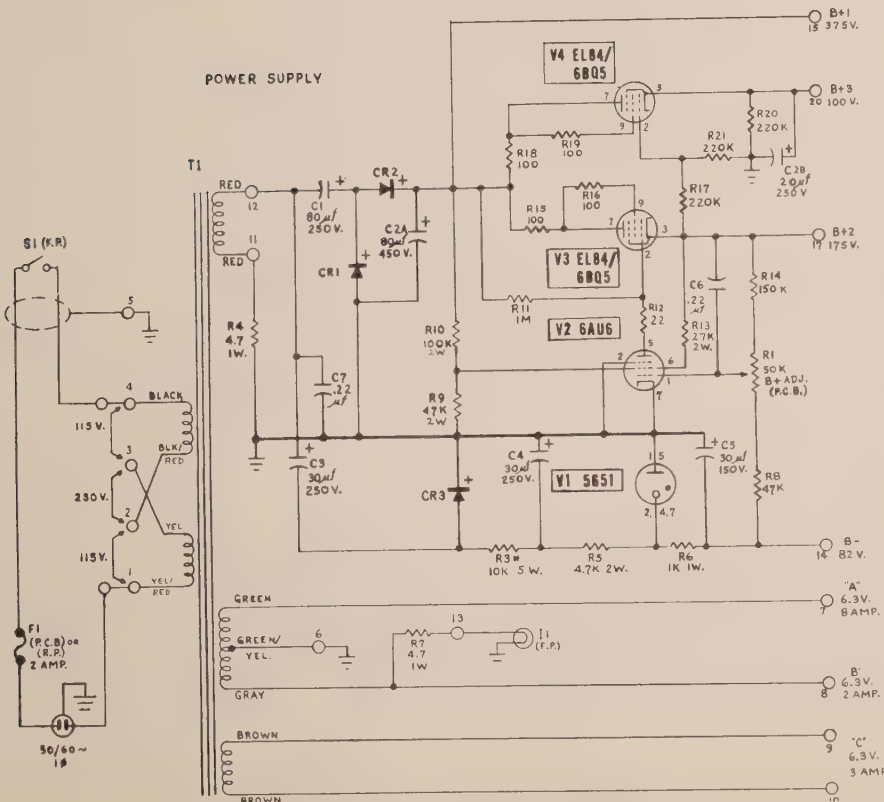
TERMINALS

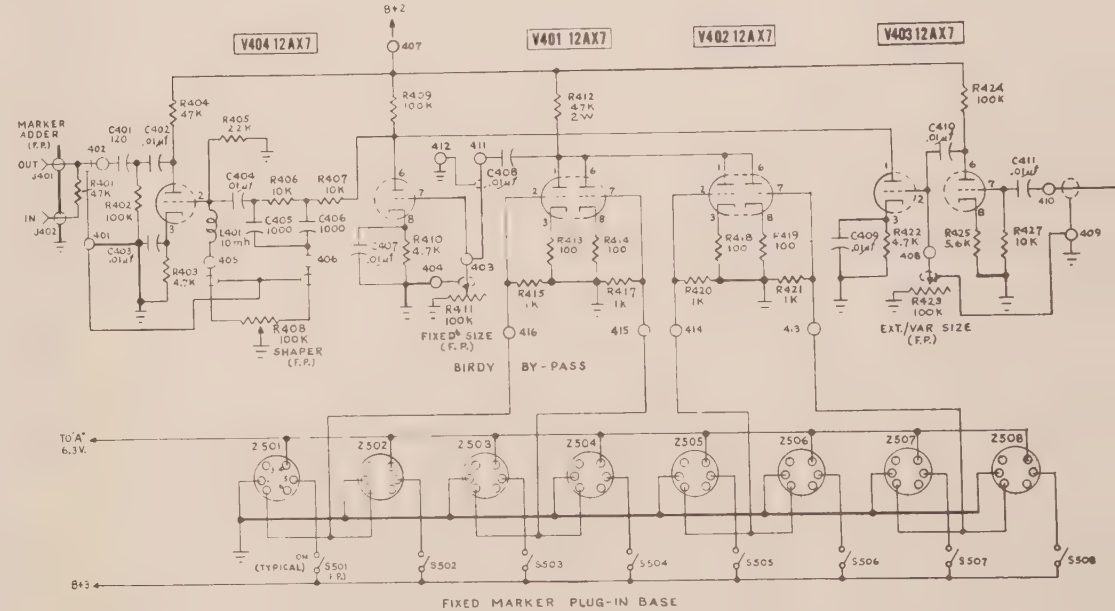
FRONT

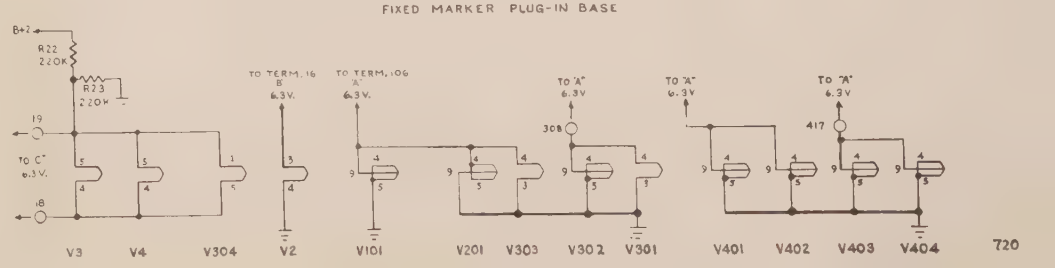


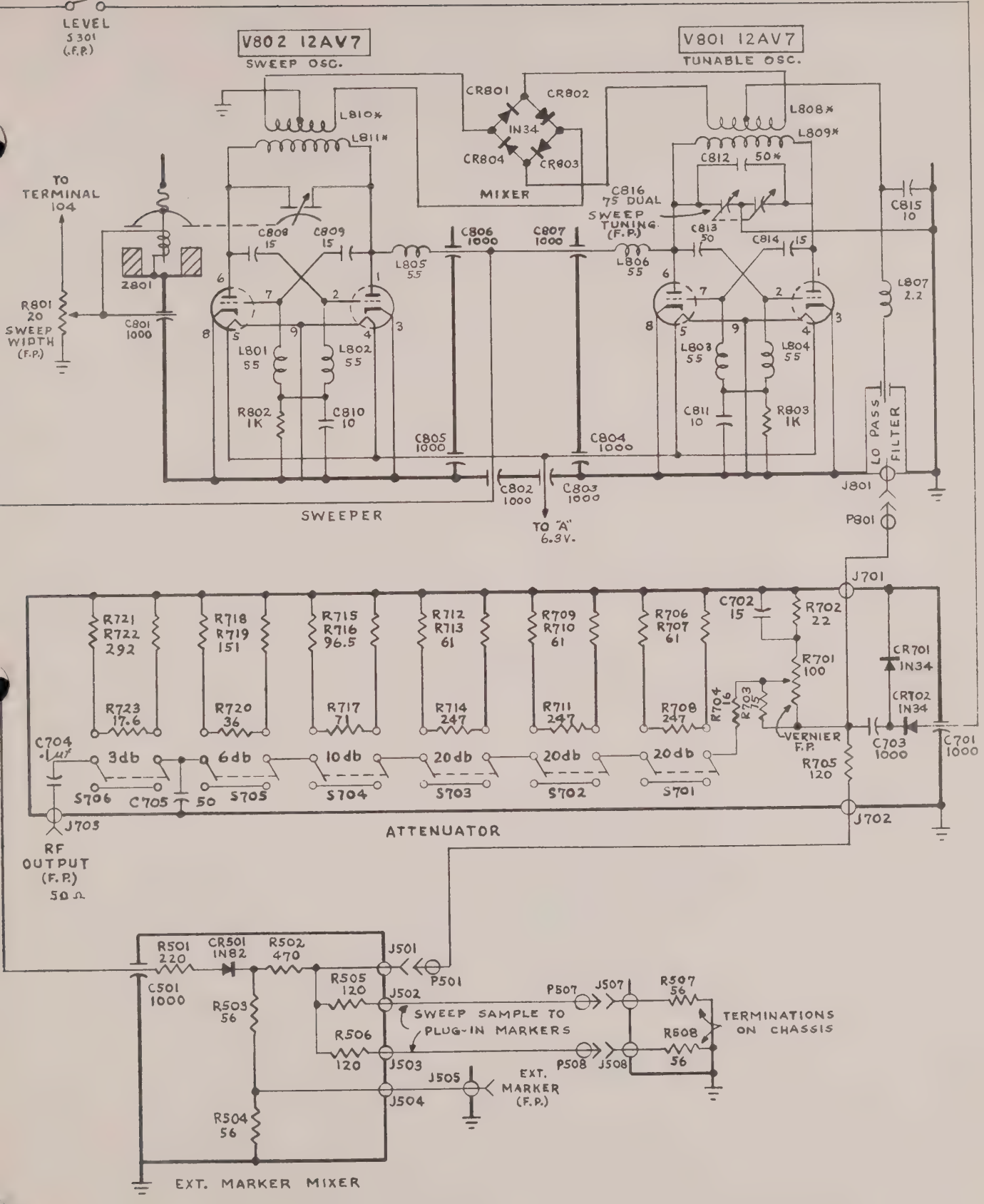

V101 12AX7
TO RB01 SWEEP WIDTH FF
R2 25 SWEEP LIMIT (P.C.B.)
R112 7.5 5W.
R104 2.2K
R101 200K HORIZ. Ø (P.C.B.)
R105 47K
C101 .1µf
C102 .1µf
R103 100K HORIZ. SIZE (P.C.B.)
R102 2M LINEARITY (P.C.B.)
R106 560K
R107 1M
C103 5000
R111 1.2 M
C104 .05µf
C105 .47 µf
LIN'TY. COMP. (GANGED W/RB01)
R108 100K
R109 27K
TO B+2
HORIZ. OUTPUT J101 (F.P.)
R110 220K
HORIZONTAL AND SWEEP DRIVE


V301 6AU6
V302 12AX7
V303 6AU6
V201 12AX7
V304 EL84/6BQ5
LEVELER INPUT
R305 10K
R306 1M
C301 .01µf
R304 560K
R307 47K
R302 50K MIN (P.C.B.)
R308 680K
R309 10K
R312 10K
R301 50K MAX (P.C.B.)
C302 50
R310 39K
R311 100K
C303 33
C304 .01µf
R204 560K
R205 560K
R206 560K
C202 .1µf
C201 .1µf
R203 560K
R201 200K BLANKING Ø (P.C.B.)
R202 1M BLANKING WIDTH (P.C.B.)
R313 1M
R316 100
R314 82
R315 100
LEVELER AND BLANKING


POWER SUPPLY
T1
V4 EL84/6BQ5
V3 EL84/6BQ5
V2 6AU6
V1 5651
S1 (F.P.)
F1 (P.C.B.) OR (R.P.) 2 AMP.
115 V.
230 V.
BLACK
BLK/RED
YEL
YEL/RED
50/60~
C1 80µf 250 V.
C2A 80µf 450 V.
C2B 20µf 250 V.
C3 30µf 250 V.
C4 30µf 250 V.
C5 30µf 150 V.
C6 .22µf
C7 .22µf
CR1
CR2
CR3
R1 50K B+ ADJ. (P.C.B.)
R3 10K 5 W.
R4 4.7 1W.
R5 4.7K 2W.
R6 1K 1W.
R7 4.7 1W
R9 47K 2W
R10 100K 2W
R11 1M
R12 22
R13 2.7K 2W.
R14 150 K
R16 100
R17 220K
R18 100
R19 100
R20 220K
R21 220K
R22 220K
R23 220K
R8 47K
B+1 15 375 V.
B+2 17 175 V.
B+3 20 100 V.
B- 14 82 V.
"A" 6.3 V. 8 AMP.
B 6.3 V. 2 AMP.
"C" 6.3 V. 3 AMP.
GREEN
GREEN/YEL.
GRAY
BROWN
I1 (F.P.)


V404 12AX7
V401 12AX7
V402 12AX7
V403 12AX7
B+2
MARKER ADDER (F.P.)
J401
J402
R401 47K
R402 100K
R403 4.7K
R404 47K
R405 22K
R406 10K
R407 10K
R408 100K SHAPER (F.P.)
L401 10mh
C401 120
C402 .01µf
C403 .01µf
C404 .01µf
C405 1000
C406 1000
C407 .01µf
C408 .01µf
R409 100K
R410 4.7K
R411 100K FIXED SIZE (F.P.)
R412 4.7K 2W
R413 100
R414 100
R415 1K
R416 100
R417 1K
R418 100
R419 100
R420 1K
R421 1K
R422 4.7K
R423 100K EXT./VAR SIZE (F.P.)
R424 100K
R425 5.6K
R427 10K
C409 .01µf
C410 .01µf
C411 .01µf
BIRDY BY-PASS
TO "A" 6.3 V.
B+3
Z501
Z502
Z503
Z504
Z505
Z506
Z507
Z508
S501
S502
S503
S504
S505
S506
S507
S508
FIXED MARKER PLUG-IN BASE


R22 220K
R23 220K
TO C 6.3 V.
.8
TO TERM. 16 B 6.3 V.
TO TERM. 106 A 6.3 V.
TO "A" 6.3 V
V3
V4
V304
V2
V101
V201
V303
V302
V301
V401
V402
V403
V404



SWEEPER
H4

Telonic
INDUSTRIES, INC.
BEECH GROVE, INDIANA

SWEEP GENERATORS

Telonic®

CATALOG 8-C

r precise measurement of frequency response . . .

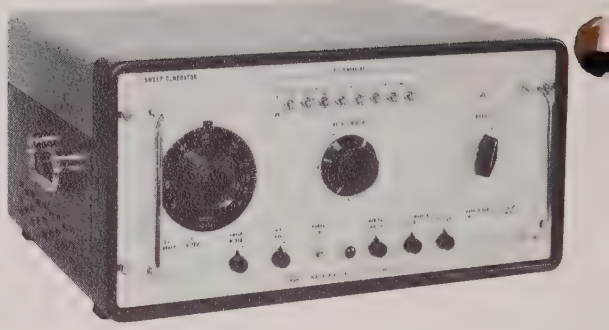
. . . in the laboratory

. . . on the production line

- *Sweep Generators*
- *Marker Equipment*
- *RF Attenuators*
- *RF Detectors*
- *RF Filters*

Telonic INDUSTRIES, INC. BEECH GROVE, INDIANA

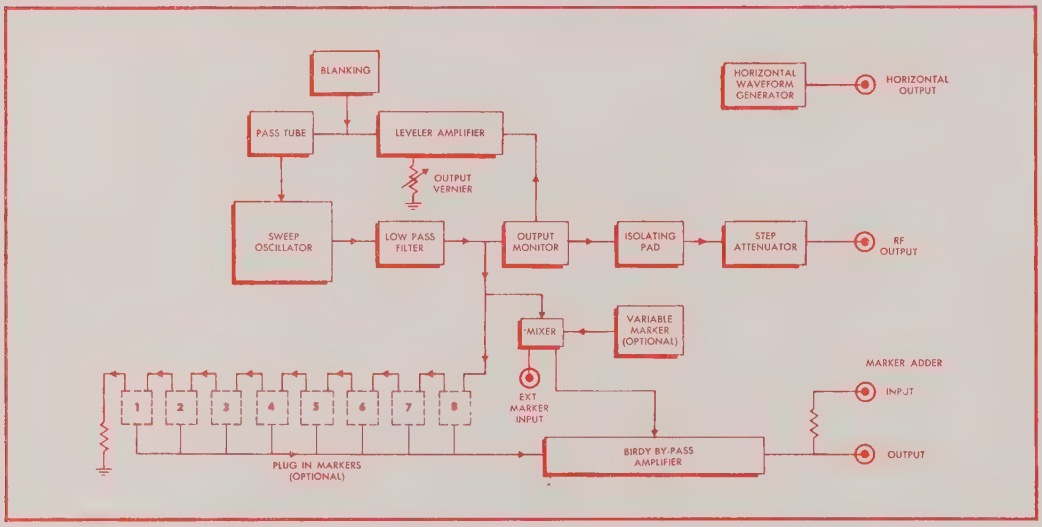
Telonic SWEEP GENERATORS



The ultimate check on RF circuit quality is frequency response. Telonic Sweep Generators permit accurate, rapid measurements of frequency response under both laboratory and production-line conditions.

A Telonic Sweep Generator scans the entire frequency range in a 60th of a second, replacing the tedious point-to-point testing normally required. At the same time, the amplitude of the swept signal is precisely controlled to produce a constant voltage input to the circuit under test.

The circuit output is normally demodulated and presented as a continuous oscilloscope trace. Precision attenuators allow quantitative measurements of the results. Internal and external markers provide automatic frequency calibration. Telonic Sweep Generators may be used to perform rapid frequency-response tests on filters, mixers, amplifiers, and a wide variety of other RF circuits.



BLOCK DIAGRAM FOR TYPICAL TELONIC SWEEP GENERATOR

ACCURATE MEASUREMENTS

The heart of every Telonic Sweep Generator is a vacuum-tube oscillator. The frequency of this oscillator is swept through the desired range by a modulator consisting of either a saturated ferrite core or a precision vibrating capacitor. A sawtooth voltage is provided for connection to the horizontal input of the oscilloscope. This waveform is in phase with the swept signal and provides the "X" axis value of the instantaneous amplitude versus frequency graph appearing on the oscilloscope. The oscillator is cut-off during the return sweep providing a flat base line on the oscilloscope for quantitative measurements.

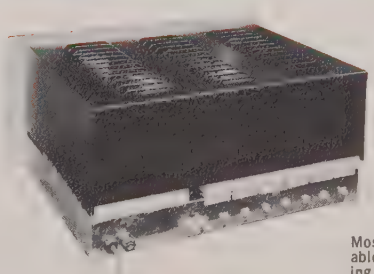
In point-to-point frequency response determinations, the power of a standard type signal generator must be adjusted each time a new frequency is selected. A Telonic Sweep Generator makes this adjustment automatically and continuously. An electronic regulator maintains the power output of the oscillator circuit at a constant level.

Accurate toggle switch or turret attenuators reduce the power input to the circuit under test by precisely known amounts. These attenuators have been especially designed for flat frequency response across the range being measured. Frequency markers are superimposed on the signal trace (see last page) *after* it has passed through the circuit under test and has been detected, preventing any distortion in the amplitude measurement.

PHYSICAL DESCRIPTION

Panel — ⅛" x 8¾" x 19"
Chassis — 2" x 14½" x 17"

Bench models are enclosed in a hinged top grey and black satin cabinet.



For rack mounting, bench models are enclosed by dust covers and finished in flat black enamel.

Most bench models are also available in portable cabinets. Provisions are included for adding up to eight plug-in markers.

GENERAL SPECIFICATIONS (Generally applicable to Telonic Sweep Generators)

Flatness.....±5% over maximum sweep width
Zero Base Line.....Oscillator off during return sweep
Sweep Rate.....Line frequency (50-60 cps)
Horizontal Sweep.....Approximately 15 volts
Vernier Attenuation.....0-10 db.

Power.....115 v. 50/60 cycle, approx. 120 watts
Display Linearity.....Better than 1.2:1
Radiation.....Less than 10 microvolts
Source VSWR.....Below 1.3:1
Markers.....Birdy-By-Pass Marker System

Variable Markers.....Available on HD-3, 4 and 7, LD, LR, SD & ED Models

Model	Center Frequency	Sweep Width	Range	Attenuation (db) (T) Turret (S) Toggle Switch	Output (into 50 ohms)	Remarks	Bulletin Number
HD-1A	.5-400 mc 390-900 mc	200kc-200 mc .06-10%	.5-910 mc	T-0, 10, 20, 30, 40, 50	.75V, p to p 1.5V, p to p	Lo band heterodyne Hi band fundamental	T-209
HD-3	.5-200 mc	200kc-200 mc	.5-300 mc	T-0, 10, 20, 30, 40, 50	.75V, p to p	Heterodyne type—wide sweep width and tunable center frequencies	T-210
HD-4	10kc-10 mc	25kc-10 mc	10kc-15 mc	S-20, 20, 20, 10, 6, 3	1V, p to p	Video sweep—wide or narrow	T-213
HD-7	100kc-75 mc	100kc-50 mc	100kc-100 mc	S-20, 20, 20, 10, 6, 3	1V, p to p	Video and IF frequencies Higher video and IF frequencies	
LD-3	4-15 mc	.05-40% of CF	3.5-17.5 mc	S-20, 20, 20, 20, 20, 10, 5, 3, 2, 1	1uV-1V, RMS	Electronically swept • Fundamental frequency type • Wide range of output levels • Exceptionally stable, flat and free from spurious content	T-214
LD-4	10-35 mc	.05-40% of CF	9-40 mc				
LD-5	20-75 mc	.05-40% of CF	16-90 mc				
LD-6	50-125 mc	.05-30% of CF	45-140 mc				
LR Series with plug-in sweeper heads				S-20, 20, 20, 20, 20, 10, 5, 3, 2, 1	1uV-1V, RMS	Similar to LD Models, but includes variable sweep rate of .01 to 100 cps and other features. For testing narrow band devices, crystal filters, etc.	T-215
PLR-3	4-15 mc	.05-40% of CF	3.4-17.5 mc			Plug-in Sweep Oscillator Heads for use with the LR series Variable Rate Sweep Generators	
PLR-4	10-35 mc	.05-40% of CF	9-40 mc				
PLR-5	20-75 mc	.05-40% of CF	16-90 mc				
PLR-6	50-125 mc	.05-30% of CF	45-140 mc				
SD-2	215-450 mc	.03-15% of CF	200-460 mc	T-0, 10, 20, 30, 40, 50	1V, RMS	Capacitive sweep Center frequency tuning Exceptionally flat VHF-UHF-low microwave applications	T-207
SD-3	440-920 mc	.06-10% of CF	425-930 mc	T-0, 10, 20, 30, 40, 50	.75V, RMS		
SD-4	930-1250 mc	.1-50 mc	900-1260 mc	T-0, 10, 20, 30, 40, 50	.75V, RMS		
SD-200		180 mc	260-440 mc	T-0, 10, 20, 30, 40, 50	1V, RMS	Capacitive sweep Fixed tuned Exceptionally wide, flat sweep Wide band applications UHF and microwave	
SD-201		175 mc	325-500 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-202		250 mc	500-750 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-203		300 mc	650-950 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-204		400 mc	800-1200 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-205		350 mc	900-1250 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-206		200 mc	1200-1400 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
ED-1A	1000-1700 mc	.02-6% of CF	975-1750 mc	Vernier 0-10 db	.3V, RMS	Output is the result of 2nd harmonic generation and filtering—and thus these ranges are obtained from the highly reliable SD type of oscillator	T-216
ED-4A	1300-2400 mc	.02-6% of CF	1350-2450 mc				
PD-1	5-50 mc	0-20%	4.2-53 mc	T-0 to 59 db in 1 db steps	4 watts Sweep & Mod. CW, 2 watts Unmodulated CW	HI POWER SWEEP & CW Generator excellent for FILTER and RF transmission line and antenna testing. Functions include Sweep; Mod. sweep; CW & Mod. CW; Internal 1000 cps modulation	T-217
PD-2	20-100 mc	0-20%	17-105 mc				
PD-3	100-250 mc	0-20%	85-260 mc				
PD-4	250-500 mc	0-20%	210-520 mc				
PD-5	300-600 mc	0-20%	250-625 mc				
PD-6	500-1000 mc	0-15%	450-1010 mc				

206A

X-2 Series — Available in ranges from c to over 100 mc. Similar to LD models t includes: CW, mod. CW, pulsed CW, ariable marker and other features. Ideal r IF amplifier testing.

BULLETIN No. T-206A

T-208

302 and 303 Test Sets — Instruments now being used for testing missile and radar IF systems — engineering, production and included as ground support equipment.

BULLETIN No. T-208

T-203B

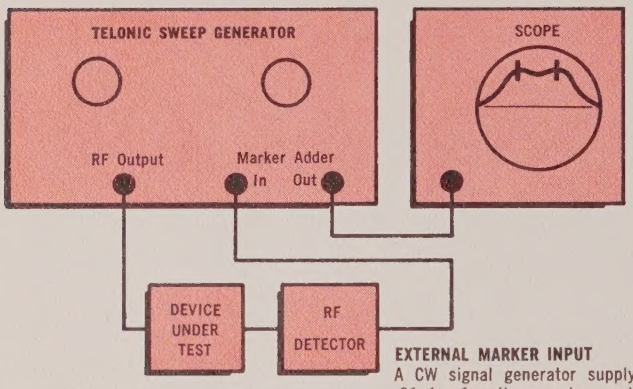
VHF and UHF TV Production Sweep Generators — Telonic Sweep Generators are used universally by almost every television manufacturer in the United States and overseas. Numerous models with unique features and special accessories are available.

BULLETIN No. T-203B

BIRDY-BY-PASS MARKER SYSTEM

In this system, beat or birdy pips are produced by mixing a sample of the sweep oscillator signal with the marker output. The "birdies" are fed through an amplifier and are added to the demodulated sweep signal before it is connected to the scope vertical amplifier. The markers completely bypass the device under test.

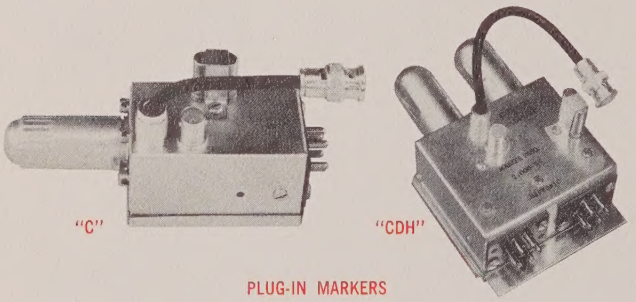
Since the markers are produced directly, no frequency error can occur other than in the marker oscillator itself. In addition to accuracy it features — stability, versatility and simplicity.



EXTERNAL MARKER INPUT
A CW signal generator supplying .01 to .1 volts may be used to produce a variable marker.

Eight plug-in sockets are included on the chassis of the HD, LD, SD, LR and ED Sweep Generators. Eight ON/OFF switches are also mounted on the front panel. This permits mounting up to eight of the "C" and "CH" type markers, up to four "CDH" type, or a combination of the plug-in types.

The "C" unit makes use of crystals up to 60 mc and generates a *single* marker by use of frequency selective circuits that combine the approximate harmonic with the swept signal sample in a diode mixer. Single markers can be produced to as high as 1250 mc.



PLUG-IN MARKERS

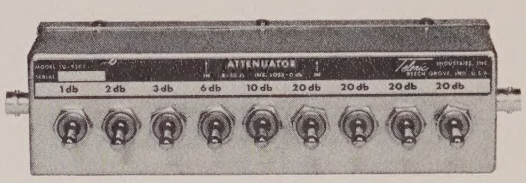
The selective circuits of the "C" unit are omitted in the "CH" units; thus a marker is produced at each harmonic of the crystal. The amplitude of the harmonics decrease therefore limiting the usefullness of the "CH" units to between the 10th or 15th harmonic.

The "CDH" circuit includes two dual triodes to greatly extend the range of harmonics. These units maintain a relatively constant level to as high as the 200th harmonic. Crystal frequencies of from 0.5 to 10 mc are normally used. Since an untuned type of oscillator circuit is used, frequency depends solely upon the crystal used.

BULLETIN No. T-218

RF ATTENUATORS

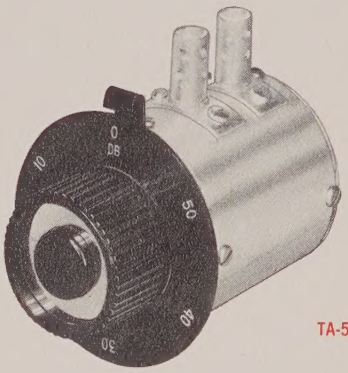
Telonic RF Attenuators are available in two forms: toggle switc and turret. The toggle switch type is recommended in the quency range, 0-250 mc. Turret attenuators may be used to 1 mc. Connectors are BNC type.



TG-950 ST ATTENUAT

Toggle Switch Attenuators are supplied in standard models co taining 6 or 9 steps, with 1.0 to 20 db of attenuation per ste Resistor accuracies are 1% and impedances of 50 or 75 ohms ma be specified. A six-step unit measures 1⅞ x 1⅞ x 5⅛.

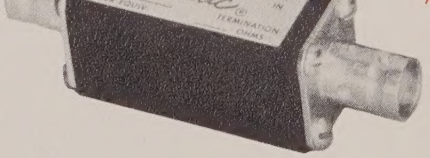
BULLETIN No. T-20



TA-50 TURRET ATTENUATOR

THE TELONIC MODEL TA-50 TURRET ATTENUATOR is a hig accurate, six-position unit providing 0, 10, 20, 30, 40 and 50 d attenuation of RF signals from DC to 1250 mc.
Other Telonic Turret Attenuators are available that provide acc rate attenuation in the 0-10 and 0-59 db ranges in 1 db steps, ar tandem units of these configurations to operate two separate ci cuits simultaneously.

BULLETINS No. T-212A and T-2



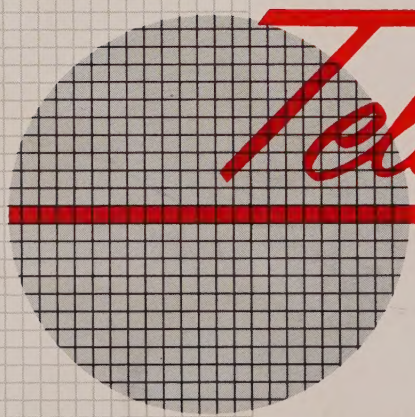
XD-3A RF DETECTOR

Telonic RF Detectors are used whenever the circuit under te lacks "built-in" demodulation or "look" points. The Telonic R Detectors are available in a wide range of impedance values. Th complete unit includes a termination resistance, an easily replace crystal diode, and a low pass filter to remove RF from the DC outpu

Model XD-3A is a 1-1250 mc detector generally recommended fo use with the HD-1, HD-3 and SD Telonic Sweep Generator Model XD-8 is recommended for use with the HD-4, HD-7 an LD Telonic Sweep Generators, and in all applications involvin the frequency range 1-250 mc. Model XD-36 is recommended fo the ED Series Sweep Generator and is designed for the range 1000-2500 mc.

BULLETIN No. T-20

Telonic INDUSTRIES, INC.
BEECH GROVE, INDIANA



Telonic

INDUSTRIES INC.

BEECH GROVE, INDIANA

84584